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JANUARY
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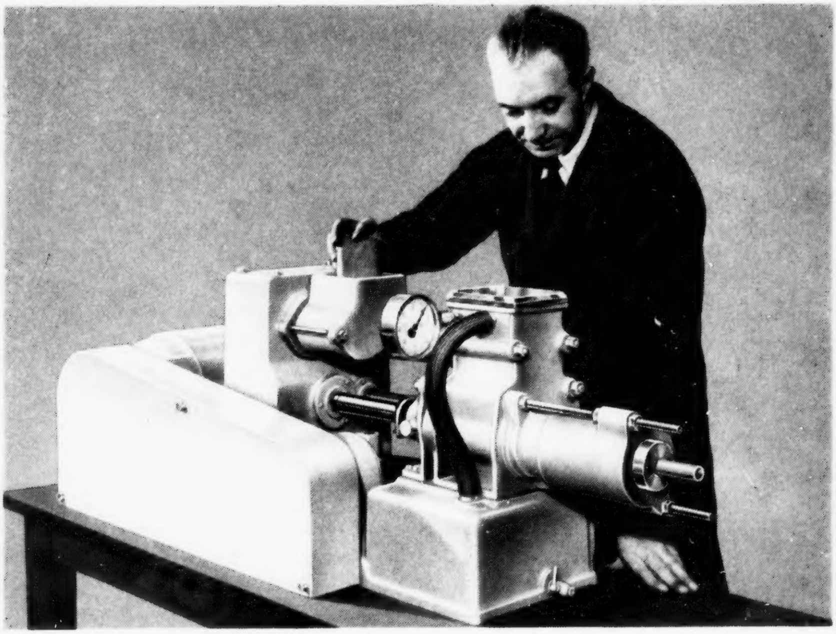

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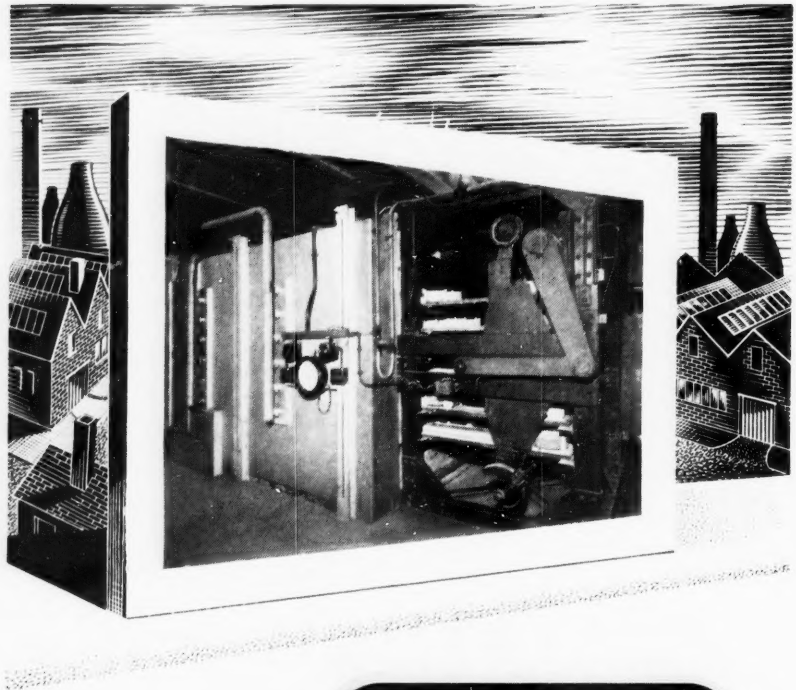

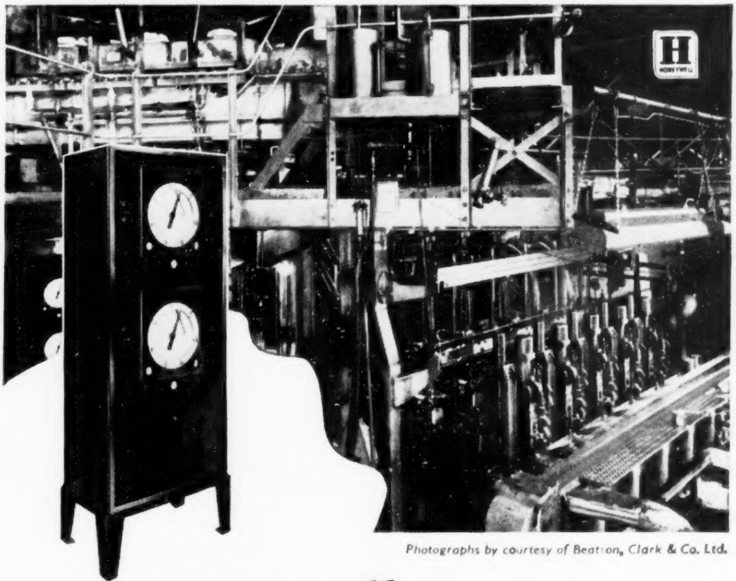

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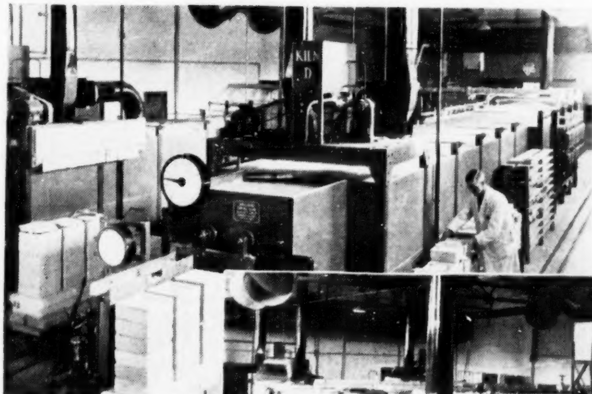

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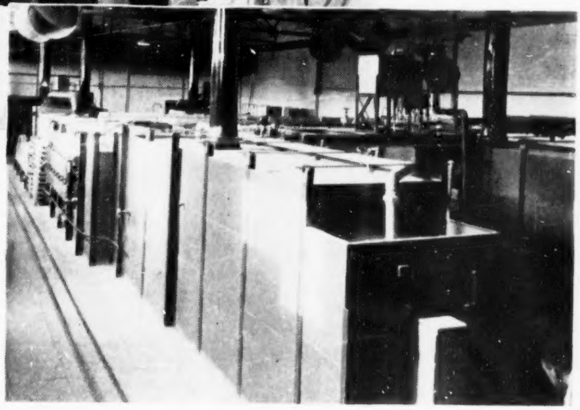

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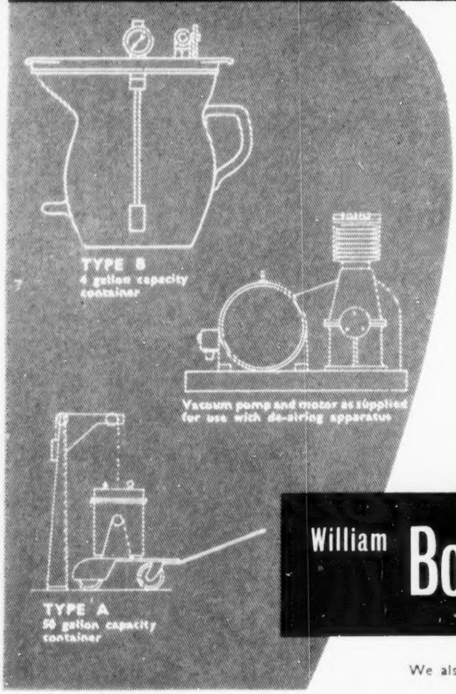

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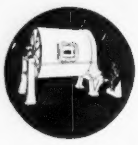
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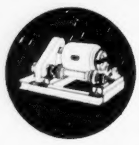
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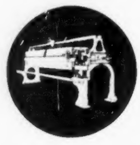
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CERAMICS

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FEATURE ARTICLES

MISCELLANEOUS

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Ceramics

VOL. V JANUARY, 1954 NO. 59

RESENTMENT !

AT 1 p.m. on a Saturday the Board of Trade tactfully released the news that Japan had paid the price of defeat!

Just as British industry is waging a stern battle in its export trade and striving hard to maintain its living standards, the little yellow man will be stealthily unloading on our very doorstep some £3½ million worth of his goods.

£50,000 is the quota for the pottery industry.

Did the Board of Trade consult Lancashire or the potteries or any industries affected? No!

For some time now there has been waged a formidable argument against the power of the accountant in productive industry. Now indeed, the National Accountant has stepped in. As was stated by Mr. W. F. Wentworth-Shields, Director of the British Pottery Manufacturers' Federation:

"The policy of allowing imports by quota, or under open general licence, simply by reference to their effect on the balance of payments and without consideration of their effect on the home industry, is intolerable. It means, if anything, that the policy is exclusively financial and regardless of the interests of industry."

One might say that £50,000 is chicken feed, but it does nevertheless represent a slice of British pottery production. At long last Japan, who since the war has been deliberately plagiarising British pottery designs and even trade marks, has opened the door to the sterling market. Of course, the British pottery industry is shocked as indeed is the Lancashire textile industry. Both have had a hard struggle to overcome restrictions on imports to overseas countries particularly in the dollar areas.

It is hoped indeed that before there is any extension of this Japanese import quota, the respective manufacturing trade associations will at least be consulted and allowed to present their case. Already the pottery industry has been adversely affected by many factors outside its control and one is not surprised to learn that this latest measure is considered by at least one of them to be a stab in the back!

Measurement and Factors Affecting

REFLECTANCE at GLAZED and ENAMELLED SURFACES

(SPECIALLY CONTRIBUTED)

THE measurement of the reflectance at a glazed or enamelled surface is a matter of some complexity. Some of the difficulties were pointed out in a recent lecture to the members of the Pottery Section of the British Ceramic Society. If it could be assumed that the surface was perfectly smooth, then it might be possible to compare reflectance by measuring the light reflected from it by means of a photocell, using a constant angle of incidence. Since, however, this is not necessarily so, the methods adopted at present are in fact a compromise, though in our present state of knowledge they probably represent the best that can be done for a routine works control.

Measurement of Reflectance

With this proviso let us consider the apparatus at present in use for this purpose. For practical purposes it is customary to consider two types of reflection from a surface, namely the diffuse and the specular.

The former is measured by directing a beam of light on to the surface at right-angles and receiving the reflected light in the opposite direction on a selenium cell. The current generated in this is measured in a sensitive galvanometer. The selenium cell and lamp are usually incorporated in a search head, which can be moved about over the surface being investigated. A green filter is interposed between the light source and the object. The object of this is stated to be correct for the difference between average daylight and incandescent light, and also for the difference between the spectral response of the human eye and the photocell.

Measurements of diffuse reflection are important on white surfaces, where it is essential to match up, for example, parts of enamelled cookers. For this purpose magnesium oxide is taken as the perfect diffuse reflecting surface or 100 per cent. white. Having a plaque of standard whiteness the instrument can be set to read diffuse reflection directly as a percentage using magnesium oxide as standard.

For comparing gloss or specular reflection it is usual to direct a beam of light on to the surface at an angle of 45° and to measure the intensity of light reflected at the same angle. For convenience a search head which incorporates lamp and photocell and arranges the angle of incidence of the light beam is available. Since some of the light reflected may also be due to diffuse reflection a correction is usually applied to the gloss reading. A deduction from the gloss reading of 10 per cent. of the value of the diffuse reflection is recommended. As a standard a sheet of black plate glass is used. This is a sub-standard, its value being referred to a perfect mirror taken as 1,000. As with diffuse reflection measurements a standard is usually supplied and when the instrument has been set on this further readings can be read off directly as percentages.

Opacification

Let us now consider some of the factors which can affect the diffuse and the specular (gloss) reflection of a surface. Diffuse reflection (whiteness) will be affected very largely by materials in the glaze, and particularly the presence of opacifiers. These all have different refractive indices from that of the clear glassy substance in which they

are embedded, and consequently light entering them from the glass will be refracted and the process being repeated many times will cause considerable scattering of the light.

A table of the principal opacifiers with their refractive indices is appended (refractive index of enamel glasses = 1·50-1·55).

		Refractive index
Tin oxide		2·04
Zirconium oxide		2·13-2·20
Titanium oxide	anatase	2·50
	rutile	2·76
Sodium fluoride		1·33
Calcium fluoride		1·44
Arsenic oxide		1·73
Antimony oxide		2·09
Cryolite		1·34
Cerium oxide		2·1
Calcium phosphate		1·58-1·62

It does not follow that since some opacifiers have higher refractive indices than others that they are necessarily more effective opacifiers. Some are more soluble in glazes and enamels than others, and it is important as far as possible to use compositions requiring the least amounts of opacifier, since many are expensive chemicals, e.g., the price of tin oxide is now around £600-£650 per ton. Moreover, they are refractory substances and tend to raise the maturing point of the glaze or enamel.

Titania Enamels

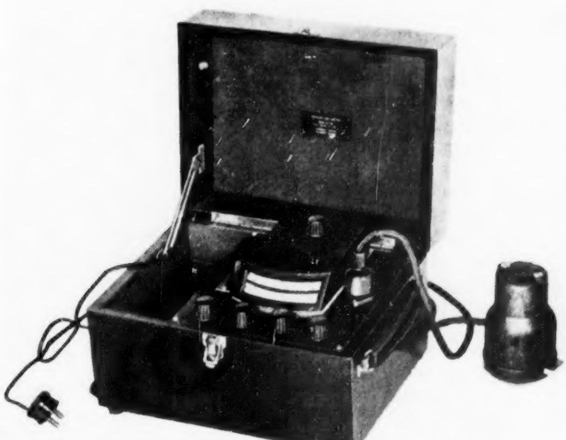
In the enamelling trade the self-opacifying frits are now widely used. These normally contain titania and opacification is produced by recrystallisation from the clear frit on heating in the enamel kiln.

To get the highest degree of reflectance the conditions of preparing the frit should theoretically be those which favour the formation of rutile, since this has the higher refractive index. Unfortunately rutile gives a creamier colour and so in practice attempts are made to stabilise the anatase form. The practical methods adopted for this are firstly to keep the fritting conditions oxidising, since if reduction occurs at any stage titanous compounds, which are blue, are formed. If the frit is refired to correct this rutile always forms. The presence of nitrate in the frit batch is desirable to counteract any tendency to reduction and the formation of bluish white enamels. Accurate batch mixing is essential and rapid cooling is desirable to stabilise the anatase.

In firing the enamel it is found that higher temperatures favour the formation of rutile. The firing temperature should be kept as low as possible, therefore.

Opacification with Zirconia

Zirconia has also been used in self-opacifying frits especially in the U.S.A. It is not as effective as titania, is more expensive, and its use has tended to diminish in recent years. While tin oxide was very expensive in the immediate post-war years mixtures containing tin oxide and zirconia were used since then the former oxide was



The Albright reflection meter

(Courtesy, Albright (Engineers) Ltd., 125 Red Lion Road, Tolworth, Surrey.)

more expensive. Zirconia is also useful in glazes where it is desired to tint the glaze with chromium oxide, since tin oxide produces the well-known chrome-tin pink colour.

Greater Variety of Opacifiers for Enamels

Tin oxide and zirconia are the only important opacifiers for glazes. With lower temperatures, such as are used in enamels, however, it is possible to use other opacifying agents.

Thus antimony oxide has been used for a long time for certain purposes as also has sodium antimonate. It cannot be used in lead frits since it reacts to form lead antimonate which is yellow. It is also not used for cooking pots on account of the danger of solution of poisonous antimony compounds. Arsenic oxide has similar limitation as regards cooking vessels. Fluorides are often used in conjunction with other opacifiers in frits for enamelling. Thus we have calcium fluoride, sodium fluoride, cryolite (Na_3AlF_6), and substances like sodium silicofluoride in use. These opacify by crystallisation of substances like sodium and calcium fluoride in the enamel and also by the formation of fine gas bubbles of what may be silicon tetrafluoride. These bubbles scatter the light and produce opacity.

Factors Affecting Gloss

Coming to specular reflection or gloss we have to consider a variety of factors which may influence the nature of the reflecting surface of the glaze on enamel. Under this heading we must consider:

(a) the composition of the enamel or glaze, since the surface can be varied by addition of substances like matting agents.

(b) firing conditions.

Effect of Glaze or Enamel Composition

It has been known for a very long time that under certain conditions it is possible to prepare glaze or enamel surfaces which, instead of being glossy, are of a matte or vellum texture.

For some purposes, such as, for example, on the surfaces of wall tiles, this effect is deliberately sought after. Matte and vellum surfaces are produced by inducing crystallisation in the glaze. For this purpose it often suffices to add to a bright glaze a sufficient quantity of whiting ($CaCO_3$) or zinc oxide. These on heating produce crystals of wollastonite $CaO.SiO_2$ or of willemite $ZnO.SiO_2$, giving what are known technically as lime and zinc matte glazes respectively.

It should be noted that certain conditions have to be fulfilled to get the effect. Over-firing can cause the formation of complex alumino silicates which partake of the nature of glasses and will not crystallise. Too rapid cooling can also sometimes produce super-cooling, and a bright surface results.

For the zinc matte glazes it is customary to use not zinc oxide alone, but a mixture of equal parts of china clay and zinc oxide calcined together. The zinc oxide alone tends to give an unduly rough surface, and the alumina present in the clay reduces the size of the crystals which form, thereby giving a smoother surface. The clay is calcined to prevent it cracking on drying. This is undesirable since unfired glazes which crack on drying often crawl when fired. Zinc mattes have a tendency to develop this failure, since they are viscous at the maturing point.

Lime mattes are produced by simply adding 20-40 parts of whiting to every 100 parts of glaze. The effect can be produced in either leadless or lead glazes. With both types there are certain limitations on glaze composition. With zinc mattes the silica is kept below two molecules in the molecular formula and boric oxide is omitted. As with all crystalline types of glaze high alumina is undesirable.

Matte glazes are not very popular since they mark easily and collect dirt. They are also not resistant to weathering. Consequently a smoother surface with some gloss, called a satin-vellum glaze is much more useful for glazed wall tiles and vases, etc. This is usually produced by adding to a glaze approximately 4 per cent. each of zinc oxide, titania and tin oxide. If fired to a temperature of 1,000-1,020° C. this produces a fine satin-vellum surface. This can be coloured to produce attractive effects, such as bluish green by adding copper oxide.

Firing Effects

Occasionally as a result of bad firing the specular reflection (gloss) from the

surface may be very much impaired. There are various effects to be considered such as:

(a) insufficient or incorrect firing.
(b) the presence of gases in the kiln which react with the glaze or enamel.
(c) volatilisation of the glaze or enamel.

The process of firing a glaze or enamel involves many stages, and it is not proposed to enter into a detailed discussion of these in this article.

Briefly, one may state that when the glaze or enamel is placed on the article and dried, one is left with a powder on the surface containing the materials of the glaze or enamel intimately mixed and gently ground, together with clay or some similar material to act as a bond before firing produces adhesion to the article underneath (either pottery or metal as the case may be), and small amounts of other chemicals added to ensure satisfactory dipping or spraying. This powder will contain entrapped air which will escape on heating. The article being glazed may also contain air, or in the case of metals, entrapped gases, which will also be given off on heating. In addition, certain chemical reactions between the constituents of the glaze or enamel will take place.

As a simple example the reaction between carbonates and silica will result in an evolution of carbon dioxide as a gas. If all these gases could be eliminated before the glaze or enamel melted all would be well. In fact this never happens, and bubbles of gas have to find their way through the molten magma. In doing this they blow holes in it, and the surface at this stage resembles photographs of the surface of the moon. Further heating should render the glaze or enamel more fluid so that these craters are melted down to give a smooth glossy surface. The extent to which this is accomplished determines how well the surface will reflect light.

In order that the melting process may be correctly done the glaze or enamel must have a composition appropriate to the firing temperature. Enamels are normally fired at much lower temperatures than glazes and

their compositions differ in important respects. If for any reason the mixture is incorrectly made and does not fuse properly under the heat treatment one may expect a surface which is harsh and which may contain holes. The semi-molten material may have only covered parts of the article giving crawling. The precise effect will be determined by the actual composition. Such a surface is immature. Similar effects follow if the firing temperature and duration of fire are incorrect. Gross errors of composition or of firing treatment are unlikely in practice, since trials are usually carried out on fresh batches of glaze or enamel and continuous temperature records are usually taken on furnaces.

A more common fault, however, is that known as "egg shell." The name describes the fault pretty accurately since the glaze is blemished with small spots resembling the pores of an egg shell. Originally, these were holes blown in the glaze by gas bubbles and the heat treatment has not closed them up perfectly. This fault, of course reduces the gloss of the surface.

Overloaded Glazes

Glazes which have been accidentally or intentionally overloaded with pitchers, flint, or a colouring oxide can also be considered here. As a result of the overloading the mixture becomes too refractory at the firing temperature to mature properly. The result is a surface which is matte instead of glossy. Occasionally devices of this kind have been used to produce matte effects, though the practice is not to be recommended.

Cooling Conditions Important

The cooling process has also a very pronounced effect on the glossiness of the surface. It is possible under certain conditions for compounds to crystallise even from glazes which are normally bright. These are silicates and they impair the surface and prevent light reflection from it. It has been shown that the possibility of crystallisation from glazes is greatest if the ware is held at a temperature between about 700 and 850° C. This sometimes happened in intermittent kilns when one section was being held back to allow others to catch up. The result is called "aired ware." For bright glazes the golden rule is to cool as quickly as possible and especially through the above temperature range.

Scumming

The presence of oxides of sulphur in the kiln atmosphere may produce what is called a scummed surface. This has poor reflectance on gloss, and is a decided nuisance on, e.g., black enamelled parts.

The scumming is due to the formation of sulphates on the surface. These arise from chemical interaction between the materials in the glaze and the enamel and sulphur dioxide and trioxide produced by combustion of the fuel. Even though the firing be done in a muffle kiln there is often a leakage of products of combustion through the muffle walls sufficient to set up this trouble.

In pottery the fault is referred to as "starring and feathering" as the crystals of sulphates often take these shapes. Black enamelled ware shows this fault at times. It may show immediately, or not until after exposure to a damp atmosphere (sometimes for several days). In the latter case the fault is called blooming. Ultimately this may develop into a white powder on the surface of the enamel. This has been reported to be sodium sulphate.

Experiments have shown that in the absence of sulphur compounds, either from gases in the dryer or furnace, no scumming or blooming forms. Thus, enamelled ware dried in electric dryers and heated in an electric oven showed no blooming or scumming. When dried in heaters operated by Town's gas (25-30 grains sulphur/100 cu. ft.) the fault appeared. When the gas was purified by removing most of the sulphur compounds the gloss was excellent.

It has also been shown that the average amount of sulphate in slop enamels caused no trouble and it requires a considerable increase to bring about scumming. The scumming is not to be confused with a fault called by the same name which arises from hydrolysis of some of the materials in a slop frit, either as a result of standing or of running the mill too hot. The soluble salts formed are mainly sodium borates and they im-

(*Continued on page* 502.)

SERVICE TO THE CERAMIC INDUSTRY

ENGINEERING—

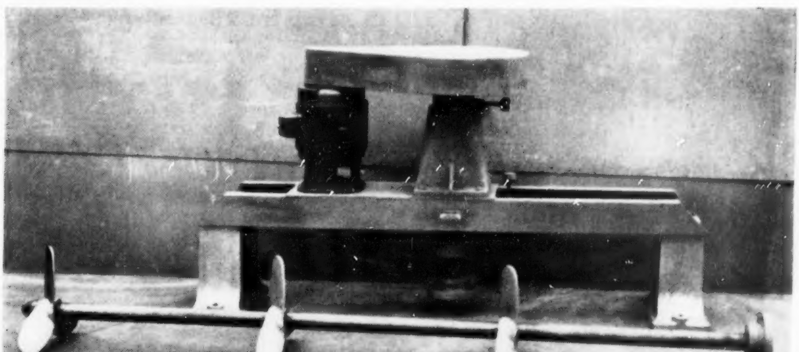
William Boulton Limited

This is the first of a series of articles which will review the history, activities and aims of firms whose service to the industry has contributed so largely to whatever efficiency and success it may now enjoy.

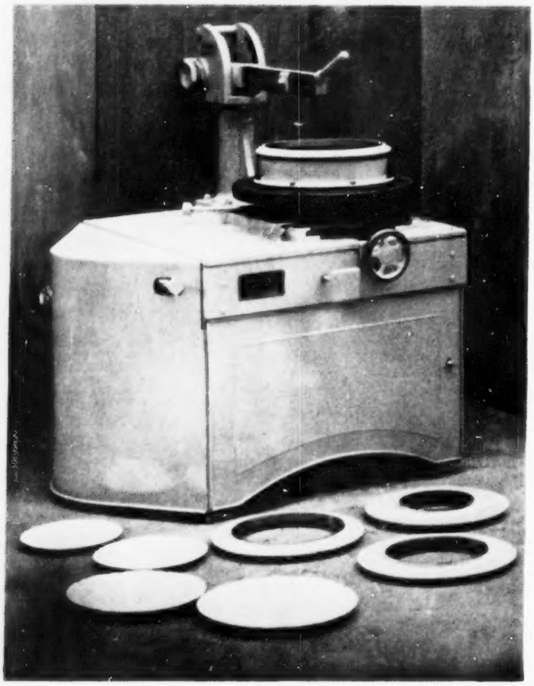
A STAFF REPORT

WITH an engineering history of over a hundred years, the name of Boulton has come to stand for more than the production of pottery machinery. It stands also for the discovery of new solutions to pressing problems, for progress and service, and for technical excellence.

The business began its long history when, in 1852, one William Boulton ventured to move from Madeley to Burslem to set up in business as an ironfounder. And in 1856, the little works having prospered, Mr. Boulton transferred his activities to the present site in Navigation Road. As time passed, an ever-increasing variety of machinery was turned out; and in this regard, Mr. Boulton was often ahead of his time. So much so, in fact, that some of his creations were not put into general use in the industry until years later. His numerous inventions included a rope drive, described in a patent of 1867 which still exists as: ". . . an improved method of transmit-



Mixing ark agitator for rapid and complete mixing



Oval dish machine

ting more power to potters' wheels, lathes, jiggers and other similar machinery for the manufacture of pottery and other articles made from clay."

It was this invention which resulted in the eventual elimination of boy jigger-turners—work which has been described by veteran potters as "slavish and heart-breaking."

Other Developments

Another development from the Providence Works of those days was the blunger—a machine which revolutionised sliphouse practice, and abolished the dirty, heavy task of "making clay" by hand. Other machines, designed in the 'eighties of last century, included an automatic cup machine which would make sixteen cups per minute. The machine won the first prize at the Paris International Inventions Exhibition of 1885, but it was not adopted by the industry.

It is no exaggeration to say that the precept and example of Mr. Boulton in the years of Victorian expansion, 1860-1890, transformed the entire pottery industry. Records show that during those years the works supplied 80 per cent. of the plant then installed. Then, as now, the firm's policy was to press on continuously to new creations, and in so doing to set the mark of distinction on everything accomplished. So successful was this policy, that today there is no pottery manufacturing centre in the world where Boulton plant is not known and appreciated.

Public Service

During these years the activities of Mr. Boulton were by no means confined to his business and engineering interests. Like many other busy men, he still found time to devote himself to extensive public service. Three times Mayor of Burslem, he also played a leading part in the life of the Wesleyan Church in that town.

Alderman William Boulton died in 1900. He left his mark on engineering in general, and in the pottery industry in particular. Arnold Bennett said of him: "A lone and wonderful genius if ever there was one, existing in the world of his own brain, and passing

over the world as if in a dream. Yet shrewd in earthly things and never to be fooled."

The family interest in the direct management of the firm ceased on the death in 1945 of Mr. Frank Boulton, last of the sons of William Boulton. Mr. T. N. Gaskell then succeeded to the chairmanship, and he retired in 1952 in his sixtieth year with the firm. Today, Mr. E. M. Breeze, who was joint managing director from 1945, is chairman and managing director. Other directors are Mr. P. A. Birchall and Mr. R. G. Dovey.

Reconstruction

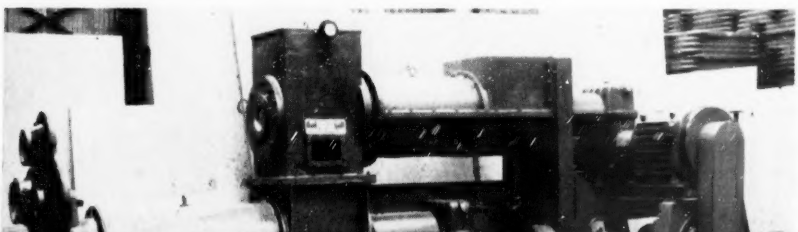
With such a tradition, it would be unlike Boulton's to speak to others of reconstruction plans without themselves being prepared to meet the demands likely to be set up by the call for mechanisation in the industry they serve. It is because of this, that large areas of new floor space, comprising new, heavy erection and machine shops, and covering 26,000 sq. ft., are now coming into production on a site adjoining the original factory.

Eventually, Providence Works will become the foundry, and the engineering shops will be completely transferred to the new site. Much progress has been made, and on a recent visit made by a representative, it was observed that the foundry is now capable of producing castings of up to 10 tons weight. Since the war, increasing demands for new types of machinery have necessitated the services of a larger staff in the department of design and development, and this was extended in 1948. In the heavy machine shop, also visited, there is carried out such work as repairs to ball mills and pan rollers. This shop is well equipped with such tools as heavy-duty planing, drilling and boring machines, and the like. Going to the other extreme, Boulton's also have a small press and die shop, and the accuracy demanded by this work calls for a high degree of skill. It was noticeable that the various shops are able in some degree to operate independently, each department being self-sufficient in such machine tools as radial and sensitive drills, shapers, etc.

The jigger shop, home of cup, bowl and flat machinery, had examples under construction of fully-automatic cup machines, semi-automatic plate machines and a cup-handling machine. Here also, are built the No. 1 and No. 2 oval dish machines. Elliptical and rectangular articles can be made on these machines, with considerable savings over other methods. Saving of labour is of the order of 30 per cent., and another advantage is that greater uniformity in the finished goods is possible.

Good Finish

A semi-automatic plate machine, seen on the works would, so far as appearance went, have graced the most modern of kitchens. Spray finished in green and cream enamel, with metal working parts heavily chromium-plated, the machine is fitted with automatic scrapper, and an Aerostyle spray gun



An extruding pugmill with variable speed on both shafts and turret head carrying various sized mouthpieces

converted for use as a water spray.

The smiths' shop also holds much of interest. It is modernly equipped with such tools as oxy-acetylene flame profile-cutters, and facilities for hardening and tempering are provided by a "Selas" gas-heated hardening furnace with a Cassel salt bath. Forged steel pug knives, and worms in numerous shapes and sizes are produced by this department.

The new foundry is a well-lit, lofty building with modern cupola and automatic charging equipment. A 10-ton Heywood overhead travelling crane is also installed, as are machines for the moulding of toothed wheels.

In the heavy erecting shop, a wide range of plant was in various stages of construction. There was, for example, a ball mill with stainless-steel lining for use in plastics manufacture, and a dust pan for tile material. Also seen was one of the latest hydraulic filter presses, described as the most efficient machine of its kind yet produced at Providence Works.

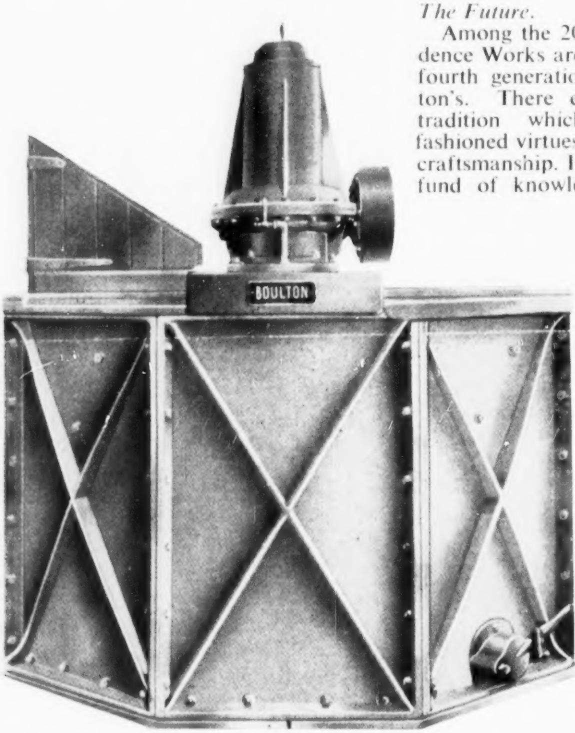
Other Activities

The firm's activities also include the re-lining by skilled workpeople of grinding cylinders. Stocks are held of porcelain tiles and Belgian Silex blocks. Works reconstruction has also made provision for experimental and sheet metal work, and the one-time millwright's department is now devoted to this purpose.

It has been said that the Company's catalogue has through the years become "a standard reference work on pottery machinery," and so numerous are the types of machines reproduced that space forbids their individual mention. However, reference may perhaps be made to some of the new machines which have gone into production during the past year or so. They include a pan specially designed to mix air-floated clay, a cup-handling machine of a new type, and a machine to make flower pots up to 12 in. dia. Other new machines were a special pug mill for electrical porcelain, and an automatic tile press.

The Future.

Among the 200 employees at Providence Works are men of the third and fourth generations to work for Boulton's. There exists, then, a family tradition which guards the old-fashioned virtues of diligence and good craftsmanship. In addition there is that fund of knowledge, coupled with a



A worm gear driven blunger

sense of responsibility at higher levels, which contributes so largely to the success of any modern enterprise. In short, as it was succinctly put by one of the firm's executives "The *job* is the Boss."

Asked for an opinion on the future of ceramic engineering, Mr. Breeze, the company's chairman, said there were signs that the continuing growth of mechanisation would bring increasing demands for interchangeability of parts, and for greater accuracy in production on the part of the engineer. They had had this in mind when equipping their new shops, and had prepared themselves by installing machine tools capable of dealing with any demand for precision work which might arise.

REFLECTANCE AT GLAZED AND ENAMELLED SURFACES.—(*Continued from page* 496.)

pair the surface especially where there is a degree of under-firing, either as a result of running a heavy load or at odd places on a large piece which have been cooler than the rest, e.g., near hooks for hanging the ware.

Sucking

Volatilisation of certain components of the glaze or enamel particularly lead compounds impair the gloss of the surface. This may arise from over-firing or from the proximity of a porous surface which can receive the vapour. Thus, in the case of firing pottery it is necessary to separate each piece by suitable kiln furniture. This is normally treated, if necessary, with a wash to make it impervious. It sometimes happens, however, that porous material gets near a glost piece and on firing the glaze is "sucked" and the result is a dry looking surface to the glaze.

Effects of Acids, Detergents, etc.

Finally, it remains to comment on the effect on the glazed surface of the various materials in everyday use in the home, such as scouring powders, fruit juices and detergents. Nowadays a good deal is known of the effects of these on enamelled and similar ware used in the home and in industry.

Where attack of the surface takes place the gloss is reduced. Generally speaking domestic appliances are now coated with acid-resisting enamels and these also show good resistance to scratching. The acid resistance is obtained by the use of compositions for enamels and glazes which are known to confer insolubility and mechanical hardness to the fired surface.

A series of tests have been elaborated to control these factors. The necessity of doing tests on the solubility of glazes and enamels intended for use in proximity to foodstuffs has been demonstrated on many occasions and an outbreak of what was thought to be food poisoning in a Continental town recently was found, in fact, to be lead poisoning, due to the use of a lead glaze on pickle jars.

Cup "Handling" Mechanised

by T. WATHEY

AMONG the cup "handling" devices designed to offset the post-war shortage of fully-skilled cup handlers are the two "Strasser" machines: the original "multi-head," and a newer development, the "single-head" (British and Foreign Patents applied for). Details of the "multi-head" type have already appeared in the issue of CERAMICS for January, 1951.

Basically, as the illustration shows, the single-head machine consists of mechanism mounted on a robust stand guarded by panels. Within is a ¼ h.p. electric motor for the operation of a simple, sturdy "handling" arrangement through a worm-driven main shaft, to which a cam is secured. Attached to this cam, and standing slightly "proud" of its face, is a freely-moving rubber-tyred wheel, the function of which will be described later. Also riding on the cam is a lifting arm, giving vertical motion to a rising and falling "handling" arm, to which is secured a hinged cradle. It is in this latter device that handles are carried during the process of slipping and "handling."

Cup "handling" machine with operative sponging "handled" cup

(Courtesy, Service (Engineers) Ltd. British Pat. No. 593,520. Prov. Pat. Nos. 17,786, 1,423, 17,317, 25,783. American Pat. No. 2,537,922. Further World Patents issued and pending.)

A further item of the machine is the sturdy upright rising from the rear of the stand, to which a horizontal arm with all necessary adjustment points and carrying a cup chock, is secured. The upright also carries the fixed end of the moving "handling" arm already mentioned. And at this point, as a precaution against side play from bearing wear, which would result in faulty placement of handles, roller bearings are standard.

Another important feature is a spring-loaded striker rod. This rides on the face of the selfsame cam by which the "handling" arm is operated. The striker pin for closing the hinged "handling" cradle is located on this rod, as is a device for opening the cradle in order to release the handle after its attachment.

Slipping

Slip is applied to the handle heads and tails by means of an applicator arm, and this is actuated through a link motion from cams positioned on the main drive. The applicator picks up the exact amount of slip required by dipping into a slip tank, which is part of the machine assembly.

A further novel feature of the machine lies in the grooving of the cup chock to carry two resilient rubber rings. These are positioned at the upper and lower points of attachment (head and tail) of handle to vessel.

As has been mentioned, handles are carried in a cradle. This is the rubber-lined hinged device which is attached to the "handling" arm. The liner, of soft rubber, is shaped to the exact outer contour of the handle to be fixed. It is designed to give a slack fit to allow for slight variations in handles, and to lend "give" at the exact moment of "handling."

In the process of "handling" (the cradle being open at the lower position) the operative places a previously cut and fettled handle in the cradle. The slip applicator (having already picked up slip from the tank) then lightly touches the protruding handle ends, and the "handling" arm continues its upward movement to a point where contact with the striker pin causes the cradle to close.

On reaching the "handling" position, the slipped handle ends make contact with the vessel in place on the chock, and attachment is completed by the application of gentle, cushioned pressure transmitted through lifting and "handling" arms from the rubber-tyred wheel already mentioned. There is a short pressure "dwell" at this point, and the cradle is then opened by a device attached to the tip of the striker rod. Then cradle now leaves the handle firmly attached to the vessel, and returns to its original position.

Meantime, the operative removes and replaces the handled article, which then has surplus slip removed by sponging. Another handle is placed in the open cradle, and the cycle is then repeated.

Cushioned Pressure

It will be apparent to the reader that in the Strasser method of handling, advantage is taken of the natural, resilient properties of rubber at three points:

(1) On the chocks in the form of rings.

(2) In the lining of the cradle.

(3) On the pressure wheel attached to the main cam.

Resilience at the chock prevents cracking inside the cup behind the points of attachment; it also assists in obviating distorted and cracked handles. In the cradle, rubber liners allow a measure of flexibility, which also helps in reducing "handling" loss. Finally, cushioned pressure at the moment of attachment ensures a full surface-to-surface contact between handle head and tail, and vessel, thus preventing sprung handles and "dry" joints.

Handles—Block and Open

Either block or open handles may be affixed by the Strasser machine, and required alterations in shapes of either vessels or handles are easily dealt with by making simple changes to chocks or cradles. In addition, the machines are so constructed as to be easily adjusted to any of the exceedingly wide variety of vessels and handles now made; and, it follows, to the widely differing bodies—earthenware, china, stoneware, etc.—commonly in use. In this way great flexibility of production is made possible.

In comparing outputs, a good hand "handler" might average 5-6 "hand-

lings" per minute with handles trimmed and cut, but speed tends to fall off towards late afternoon—as does, in some cases, accuracy of positioning. With the Strasser "single-head" machine, on the other hand, ten cups per minute can be "handled" and sponged by an unskilled operative. Slip is mechanically applied, and the handle is securely and accurately fixed while the operative sponges the cup "handled" in the previous cycle. Handles, of course, are supplied to the operator ready cut, fettled and sponged. Speeds giving six to eight "handlings" per minute are also incorporated in the machine for training purposes. However, factory conditions vary, and fourteen "handlings" per minute have been achieved.

It is often said that "A cup is only as good as its handle," and this saying is borne out by the fact that a high proportion of cup losses at all stages are due to such "handling" defects as cracking and distortion of cups in the region of the handles, and to sprung handles, cracked handles and handles misplaced. It is claimed by the designers of "handling" appliances that these losses can be reduced by the adoption of mechanised "handling" and that, at the same time, increased outputs from unskilled workers at a lower cost can be obtained.

Thanks are expressed to the inventor and patentee, Mr. H. Strasser, and to Service (Engineers) Ltd., for facilities afforded to the writer of these notes.

"PRODUCTION FOR PLENTY"

AN exhibition sponsored by the Institution of Production Engineers, who are also arranging for a conference to take place at the same time, will be held at Olympia, London, during July, 1954.

The main purpose of the exhibition, which will be organised by the Building Trades Exhibition Ltd., is to show how improved production methods are reducing the time lag between research and production and how research into greater productivity ensures that more, better and cheaper goods become available to the consuming public.

Further details can be obtained from: The Organising Secretary (Mr. S. D. Cooke), Room 11, Avenue Chambers, 4 Vernon Place, London, W.C.1, or from The Secretary, The Institution of Production Engineers, 36 Portman Square, London, W.1.

Infra-red Panels.—From Thomas De La Rue and Co. Ltd., 84/86 Regent Street, London, W.1, we have received recently published literature dealing with gas-fired space heaters, and under the title "Have you a drying problem?" details of De La Rue infra-red process panels.

Midlands Office.—Samuel Denison & Son Ltd., makers of weighing and testing machines, with head office at Hunslet Foundry, Leeds 10, announce that they have opened an office at The White House, 111 New Street, Birmingham 2.

G.W.B. Electric Furnaces Ltd. inform us that, owing to the extension of their business to other products, it has been thought necessary to change the title of the company. From 1st January therefore, the company will be known as G.W.B. Furnaces Ltd. The policy and administration of the company and addresses of the company's registered offices, works and branch offices will remain unaltered. The company is still a separate entity, wholly owned by the proprietors, Gibbons Brothers Ltd., of Dudley, and Wild-Barfield Electric Furnaces Ltd., of Watford. The products of the company now include electric resistance, arc and induction furnaces; steam raisers and water boilers heated by oil, gas and electricity; electric control gear and case-hardening compounds.

Anglo-American Agreement. — Chamberlain Industries Ltd., of Staffa Works, Leyton, London, E.10, well known as manufacturers of "Staffa" products, including tube-bending machinery, hydraulic equipment and mobile cranes, announce that they have made an agreement with Walter P. Hill, Inc., of Detroit, Michigan, U.S.A., design and development engineers making special purpose machinery, principally for the production and testing of engineering parts made from tube and plate. The agreement covers the manufacture by Chamberlain Industries Ltd. of Hill products and their sales outside the U.S.A.

The first machine to be marketed under this agreement will be a new type of production bender for small tubes and other sections.

The Drying of Tableware and Other Ceramic Goods

By the Jet Drying Method

by W. HANCOCK, M.I.B.R.E., A.M.I.E.E.

3.—THE JET DRYING OF LARGE AND SMALL FLATWARE AND SAUCERS

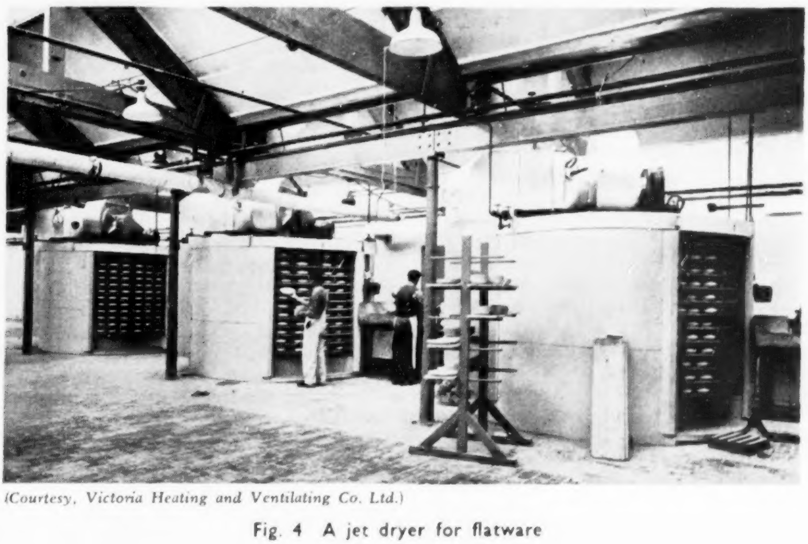
A JET dryer as used for 8- or 10-in. flat, trade sizes, (10 in. and 12 in. actual) is illustrated in Fig. 4.

The mould capacity of this dryer is 264, and although the power used is 2·6 k.w.h. as compared with 1·94 for an ordinary octagonal dobbin in the same shops dealing with a similar rate of making, the power (converted to B.Th.U. per lb. of water evaporated) is 88 as against 98 for the ordinary dobbin. This is due to the more rapid rate of drying obtained in the jet dryer, namely 45 min. instead of 2 hours in the dobbin.

Construction and Comparative Fuel Data

Dimensions of this jet flat-dryer and general production data and fuel consumptions are shown in the accompanying Table, with comparative data for the older rotating dobbin, non-jet unit. (Table, page 510.)

As with the cup dryer, the jet dryer for flatware is circular in plan, and is divided into twelve sectors. In the dryer illustrated in Fig. 4, there are eleven hollow shelves in each sector, each shelf carrying two moulds, giving a total mould capacity of 264.



(Courtesy, Victoria Heating and Ventilating Co. Ltd.)

Fig. 4 A jet dryer for flatware

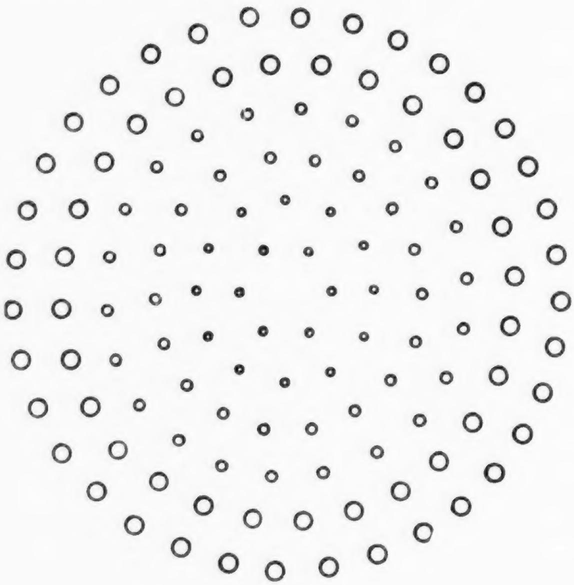


Fig. 5.
Jet plate for large flatware with jets arranged in concentric circles

(Courtesy, Victoria Heating and Ventilating Co. Ltd.)

The shelves, apart from supporting the moulds and clay, perform two other functions:

(a) They act as air conductors, the air under pressure passing from the central air reservoir, fed by the fan.

(b) The lower sides of all the shelves except the bottom one are perforated in a scientific pattern, the perforations acting as the jets. The disposition of these jets is discussed below.

As a consequence of a slight reduction in the thickness of each hollow shelf, the latest flat dryers carry twelve shelves without any loss in convenience of loading and unloading. This extra shelf increases the mould capacity of the dryer from 264 to 288, an increase of 9 per cent., which enables either (a)—the making of flat to be correspondingly increased without altering the time of drying, or (b)—the rate of drying to be proportionately reduced if any advantage is to be gained from such reduction.

Influence of Jet Dispositions on Shape of Articles and Safe Drying. Control of "Humpers" and "Whirlers."

With flat, *especially large flat*, early experiments with the jets arranged in a series of concentric circles above the articles showed that "humpers" and "whirlers" could be produced at will. Concentration of the jets above the centre backs of the plates produced "whirlers." On the other hand, positioning the jets above the plate flanges, with no jets over the centre back, produced "humpers." A satisfactory compromise was reached by having no jets over the 2-in. dia. circle above the plate centre, as shown in Fig. 5.

In present practice, the three outer circles of jets are $\frac{1}{4}$ in. dia., with the three inner circles at $\frac{1}{8}$ in. dia. With this arrangement of the jets, natural drying is imitated in that edges and flanges dry before the centres.

Distance of Jets from Articles

With flatware, and shelves which are themselves flat on the lower faces, the distances of the jets from the surface of the article beneath varies according to the tool profile, and the actual shape of the flatware. Generally speaking, rates of drying increase as the distance between the jets and the drying surface decreases, hence the value of larger jets in the three outer concentric circles.

Air Velocity at the Jets, and Drying Rates

So far as is known at present, with

other factors equal, drying rate is almost directly proportional to linear velocity of air through the jets. This is in agreement with Stacey's guiding rules for evaporation rates of water from a free water surface, and may be taken as practically correct during the contraction range of the drying period.

Hitherto, in flat dryers, jet velocities have been brought up to approximately 500 ft. per min., but in dippers' dryers jet velocities up to 2,000 ft. per min. are now in use. With clayware, the economic limit for maximum linear velocity of air-flow through the jets is not yet known, but it is known that the drying rate falls gradually when the contraction period is completed, and that an increase in air velocity can boost the falling rate.

There is little doubt that the present drying times of 40-50 min. in jet dryers can still be safely reduced by control of arrangement of the jets, and by the use of still higher linear air-velocities at the jets.

Dry-bulb Temperatures and Life of the Moulds

It is now clearly understood that rapid deterioration of plaster moulds occurs when plaster is heated above 60° C. (140° F.). From the graph, Fig. 6, it will be seen that (a) the jet temperature remains steady to within ± 1½° F.—with an average of 134° F.—the early fluctuations being attributed to a minor adjustment of the Sarco-Spirax automatic controller to arrange an average temperature of 135° F. With normal running, this temperature does not vary by more than ±0·5° F. (b) The mould temperature never rose above 109° F., presumably due to the protective influence of the article during drying. (c) The wet-clay temperature rises quickly towards the wet-bulb temperature of the jet air at about 88° F., remains steady presumably until the contraction period is completed, and then rises slowly to an equilibrium temperature at the end of the drying cycle.

As a consequence of it becoming impossible to heat the plaster to 140° F., and as a further consequence of the protective effect of the article on mould temperature, a long life may be expected, and is in practice being obtained from all moulds used in the jet drying of ceramic goods, with complete absence of deterioration of the mould due to the chemical dehydration of plaster.

Correct Positions for Re-circulating and Bleed-off Ports

Empirical tests during the develop-

Fig. 6.
Graph showing time/temperature curves for jet, mould and plate.

(Courtesy: Victoria Ventilating and Heating Co. Ltd.)

TABLE OF COMPARATIVE DATA FOR JET AND DOBBIN DRYERS.

Dimensions and Capacities						Steam				Electricity			Total
Type	*Floor Area and Height*	*Floor Area sq. ft.*	*Type of Heating*	*Drying Time hr.*	*Moulds in Dryer*	*Pressure lb./sq. in.*	*Consumption lb/hr.*	*Consumption /lb. of water evaporated*	*B.Th.U./lb. of water evaporated*	*3-phase amps. per phase*	*K.W.H.*	*Power as B.Th.U./lb. of water evaporated*	*B.Th.U/lb. of water evaporated*
Jet Dobbin	Circular 9½ft. Dia. x 9½ ft.	78	Steam, hot-air jet	¾	264	5/10	120	1·20	1200	6.0	2·60	88	1288
Dobbin	Octagonal 4½ ft. x 4½ ft x 13 ft.	97·2	Steam, hot-air	2	480	5/10	133	1·97	1970	4.5	1·94	98	2068

TABLE OF COMPARATIVE DATA FOR JET, DOBBIN AND MANGLE DRYERS.

				Steam				Electricity			
Type	*Floor area sq. ft.*	*Drying time hrs.*	*Moulds per dryer*	*Pressure lb./sq.in.*	*Consumption/lb. hr.*	*Consumption /lb. of water evaporated*	*B.Th.U./lb. of water evaporated*	*Amps. per phase 3-phase*	*K.W.H.*	*Power as B.Th.U. /lb. water evaporated*	*Total B.Th.U. /lb. water evaporated*
Jet	33	¾	240	5/10	20	0·86	860	1·5	0·66	95	955
Dobbin	97·2	1¾	600	5/10	45	1·80	1800	4·5	1·94	264	2064
Mangle	32	1¼	480	5/10	60	2.13	2130	4·5	1·94	236	2366

ment stages suggested that the best positions for the re-circulation port would be between the second and third sectors inside the stove proper at the in-going end—and for bleed-off at about the third sector in from the out-going end of the cycle.

That the decisions made as a consequence of practical trials were correct, was later confirmed by sending a Gregory relative—humidity indicator and a dry-bulb temperature indicator around a flat dryer (8 in. flat) during a drying cycle.

The results obtained are shown in the Table below:

B.Th.U's, as against 1,970 B.Th.U's for the ordinary dobbin (approximately 40 per cent. less) and for power 88 against 98—approximately 10 per cent. less.

For smaller flat, e.g., saucers, similar relative data are: for steam, 860, 1,800 and 2,130 B.Th.U's per lb. water evaporated for the jet, dobbin, and mangle respectively, or greater than 50 per cent. steam economy in favour of the jet as compared with the dobbin, and 60 per cent. in comparison with the mangle, plus power economy of between 50 and 60 per cent. as compared with the other two units.

Position	° *F. dry bulb*	*Gregory rel. humidity*	*Position*	° *F. dry bulb*	*Gregory rel. humidity*
In shop	65	37	Sector 7	124	18·5
Sector 1 (open)	not taken	73	,, 8	120	18·0
,, 2	100	35/50	,, 9	128	18·5
,, 3	118	50/22	,, 10	126	18·0
,, 4	126	22/19	,, 11	128	19·0
,, 5	125	19/18	,, 12 (open)	falling	open and changing
,, 6	124	18/19			

The correct positioning of the points for bleed-off to the atmosphere and for air pick-up for re-circulation within the stove are important as regards over-all thermal efficiency, and for satisfactory completion of the drying of the ware on a rapid drying cycle.

The Jet Drying of Smaller Flat and Saucers

The Table (page 510) gives a comparison of the sizes, capacities and fuel consumption (steam plus electricity) for a jet saucer dryer, a mangle dryer and a modern dobbin of the non-jet type, all working on the same ware at one factory.

Thermal Efficiencies of Jet Flatware Dryers

Reviewing the fuel consumption data presented in this article, it will be seen that the total fuel consumptions in both large and small flat jet-dryers are considerably lower per lb. of water evaporated than with other types of dryers in use *on the same factories and working on similar sizes made from the same bodies.*

Thus, for the larger flat, the steam consumption for the jet-dryer is 1,200

Flame Spraying Ceramics

by

THOMAS A. DICKINSON

A "FLAME SPRAYING" technique now being developed by Ryan Aeronautical Co. at San Diego, Calif., is expected to permit the application of heat-resistant ceramic coatings on such materials as aluminium, magnesium, and titanium as well as iron and steel.

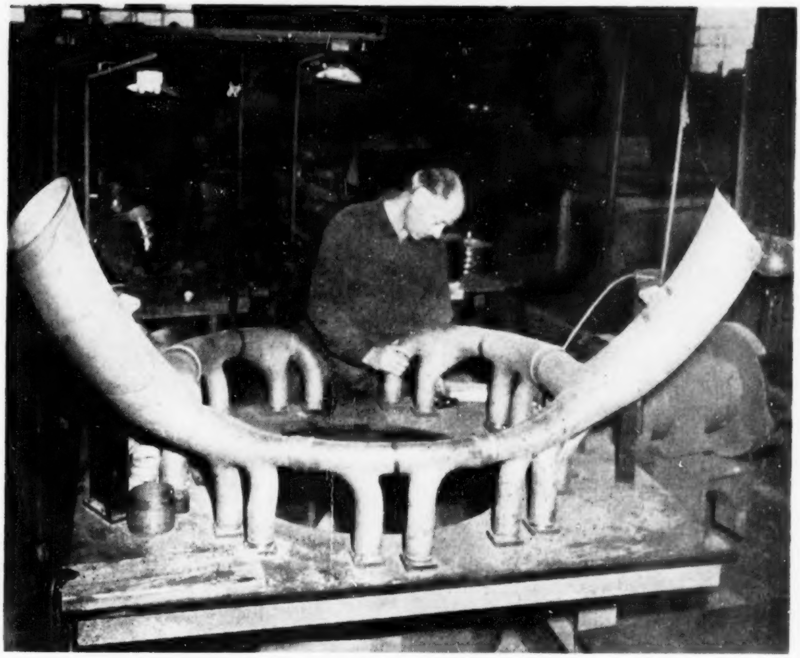
It consists briefly of pneumatically ejecting fine refractory powders through a flame with a spray gun of the type that has been developed for metallising purposes by the Schori Process Division of Ferro-Co. Corp., New York. The powders are temporarily melted by the flame, so that they can be bonded to various metallic surfaces without causing any appreciable amount of oxidation.

Besides permitting the use of ceramics on materials that could not previously be coated with refractories, this procedure eliminates the need for the dehydration ovens, furnace facilities, and much of the time that has heretofore been required to apply vitreous enamels.

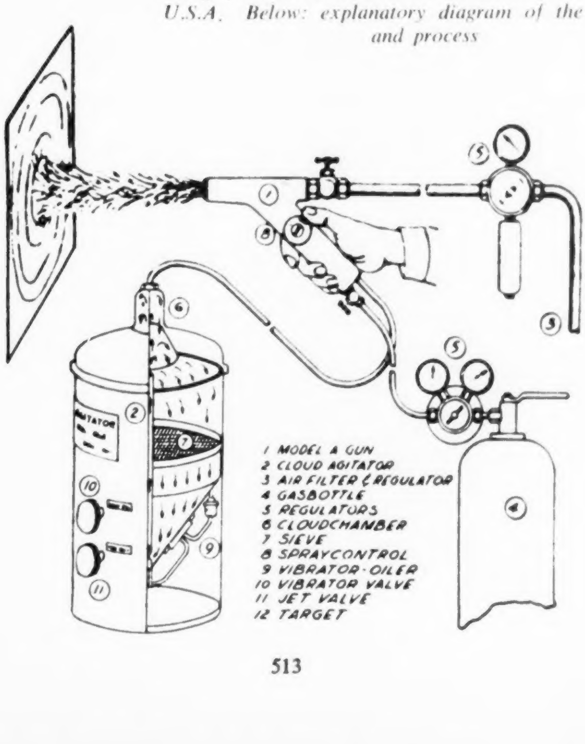
It is unlikely that the process will replace conventional enamelling techniques because flame-sprayed coatings normally have a rather rough texture, which would probably not be acceptable on many commercial products. However, such coatings are as good as and perhaps better than standard ceramic finishes for strictly utilitarian purposes (that is, on components or products which must withstand extremely high operating temperatures) because they may comprise refractory materials with much higher melting temperatures than the metals to which they are applied.

While they have definitely proved that ceramics can be flame-sprayed on materials such as aluminium and magnesium without damaging the metals, Ryan engineers do not consider the new process a completely practical development for one reason: they do

Small parts can be flame-sprayed automatically in a lathe set-up of the type shown here



Above: exhaust systems of the type shown here are now being finished with ceramic material coatings in the U.S.A. Below: explanatory diagram of the equipment and process



Large surfaces are better treated by the use of a manually controlled gun as shown here

not yet have coating formulæ which will make it possible to apply ceramic fiinshes with approximately the same thermal expansion coefficients as those of most metals on which such finishes would be desirable.

For example, while it is now possible to bond a ceramic coating to the surfaces of an aluminium component, there is as yet no known refractory coating that will remain bonded to aluminium when the materials are heated enough to expand appreciably. This would not be an objectionable feature in finishing products that merely require high chemical resistance at room temperature, but it does limit the use of ceramic coatings on articles that require extra heat resistance.

At present, the only refractory finishing materials that are known to be suitable for use on metals which must withstand high operating temperatures are A-19, A-417, and A-418 compositions developed by the American National Bureau of Standards. These materials are suitable for finishing low-carbon steels, stainless steels, Inconels, etc.

However, aircraft engineers seem to be confident that research will eventually yield oxide combinations which will satisfactorily impart added heat resistance to virtually all metals.

Flame spraying will make the use of such materials practical because metals like aluminium, magnesium, and titanium would oxidize or melt before ceramic coatings could be applied to their surfaces with standard vitreous enamelling facilities.

Materials to be finished with flame-sprayed ceramics are cleaned and sand-blasted or chemically roughened in a conventional manner, prior to the application of ground and cover coatings.

Ground coatings are built up slowly by making a series of rapid passes over a surface area which is usually not more than a yard square, in order to avoid the excessive heating of deposition surfaces. Cover coatings are applied with about the same speed as metal-spray finishes.

Separate ground and cover coatings are normally applied in order to get maximum adhesion and desired colour effects. However, it is entirely possible that future developments will yield ceramic compositions which will respectively serve both ground and cover purposes.

Unlike metals, ceramic powders have no tendency to undergo a change in composition when they are flame-sprayed in open air because they are oxides from the start. Further, because they are chemically inert,

ceramic coatings will not ordinarily promote oxidation or corrosion in metals to which they are applied.

The primary purpose of ceramic coatings used by aircraft manufacturers at present is to conserve critical materials—for example, by permitting the use of mild steels in place of stainless steels where the heat resistance (but not the mechanical strength) of the latter is essential. However, in view of the fact that ceramics can be flame-sprayed almost as economically and efficiently as solvent-dispersed coatings, it seems at least probable that refractory finishes could be used for certain low-temperature applications where organic coatings have never been completely satisfactory—for example, in the protection of seaplane hulls and floats.

SCHOOL OF MATERIALS HANDLING

FOR some eighteen months courses of lectures on the handling of materials have been given by a team of lecturers, in many parts of the country, who have for years past specialised in this very important branch of production technology. It was realised, from the start, that these courses were but a palliative to more advanced and prolonged studies and steps have now been taken to provide more advanced and detailed courses. To do this it has been necessary to take over larger premises and an estate of some 17 acres has been procured in order to develop this educational work still further. It has been the aim of the founder from the time he launched the School of Materials Handling to set up a College where both theoretical and practical studies could be combined. This has now been achieved.

Curricula have been submitted and the names of College of Production Technology and School of Work Study have, in addition to School of Materials Handling, been officially approved by the authorities. This educational work is now being carried on under the title "College of Production Technology incorporating School of Materials Handling and School of Work Study."

The following are some of the courses and facilities now available through the college.

Full-time Three Term Courses in each of the following subjects:

Production Technology
Materials Handling in Industry
Cargo Handling—in collaboration with the International Cargo Handling Co-ordination Association.

Each course is of one year duration. Term times: May to July, September to December, January to March.

Part-time Evening Courses in each of the following subjects:

Production Technology
Materials Handling in Industry
Cargo Handling
Work Study.

These courses are of three-year duration. Term times: Same as for full-time courses.

Home Study Courses in each of the following subjects:

Materials Handling in Industry for Industrial Executives, Production Engineers, Factory Managers and Sales Engineers
The Design of Mechanical Handling Equipment for Estimators, Designers and Draughtsmen.

These courses may be started at any time.

Special Courses

In response to a number of requests, courses have and are being set up devoted entirely to specific industries as opposed to courses designed to cover the handling of materials in industry generally. The Principal is at all times prepared to consider the setting up of such courses both in this country and overseas.

Advisory Service

The Panel of the College is made up of both practical and theoretical experience and realize that many companies and individuals have handling problems. For this reason an advisory service has been set up to help solve them and the service is at the disposal of the whole industry. To those taking courses of study, the service is free but a small charge, depending on the size of the problem, is otherwise made to help support the educational work of the college. This service has already dealt successfully with 133 problems.

Further details of all the foregoing may be obtained from the Secretary, College of Production Technology, Swinford Old Manor, near Ashford, Kent.

As part of the practical work of the College, demonstrations of equipment are being arranged to which representatives of companies interested in this scheme and who may wish their equipment to be included in these demonstrations are invited to write to the Assistant Secretary of the College, marking their letters "Demonstration."

PROGRESS AT BILTONS (1912) LTD.

MUCH interest was attached to a recent exhaustive tour of the factory of Biltons (1912) Ltd., manufacturers of glazed tiles and domestic tea ware, made by a small party of visitors under the leadership of Mr. A. R. Harley-Jones and Mr. P. T. Tellwright, directors of the company.

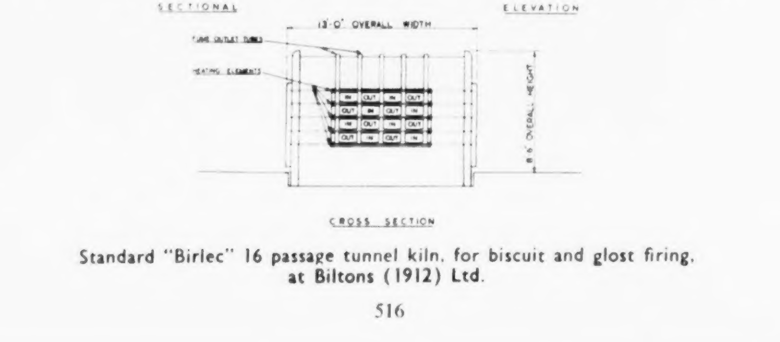
Continuous growth sums up the history of the organisation, which was founded in 1912 by Mr. J. Tellwright. The factory of forty years ago employed twenty operatives in the production of red teapots; today's enterprise covers three acres and finds work for 360 workpeople, two-thirds of whom are women.

Glazed tiles were first made in 1934, and since then a high degree of mechanisation has been achieved. The "body" from which the tiles are made, for example, is untouched by hand from the time the clay goes into the blunger until the woman press-operative has made the tile.

In producing the "body," slip from the blunger is dried on rotary steam-heated drum dryers designed on the works, which each week between them, dry 30 tons of material down to a predetermined moisture content. The "body" is then cooled and rested for 24 hours, when it moves by conveyor to the making shop.

Machinery and Ovens

Tile-making machinery consists of a pair of Collingham and Owen fully-automatic presses (as made by Sheepbridge Equipment Ltd.) together with eleven semi-automatic and five fly presses. Special shapes are cast. Biscuit firing is done in a producer gas-fired tunnel-oven, installed in 1929 for firing earthenware by Marlow, whence the tiles move to a Gosling and Gatenbury dipping machine where conveyorised, high-speed glazing is carried out. Mottled effects are produced by hand in another section of the same shop.



Standard "Birlec" 16 passage tunnel kiln, for biscuit and glost firing, at Biltons (1912) Ltd.

At this point it is of interest to record that these works were the first to receive a low-solubility glaze certificate.

Glost tiles are fired in a Davis-Revergen tunnel oven. Embodying the principle of the reversible generators for preheating primary air, the oven takes the output of the tile works, which is approximately 2,500 yards of tiles and 600 dozen pieces of faience per week. Gas consumption is 2,700 c. ft./hour.

Whiteware Production

It was at the end of the First World War that the production of whiteware was started, and here, too, a policy of mechanisation has been pursued. A process, it should be added, which has been considerably speeded up since the works was reopened after being closed during the last war.

In the making shop, for example, besides ten hand-operated machines, there are now eight semi-automatics, four for cups and four for flat ware. All these are of Boulton make, except one Gosling and Gatenbury cup machine. Three Strasser machines take care of cup handling, each dealing with fourteen cups per minute. A Biddulph conveyor cup dryer is here used in drying the cups, and this gives flow production from handling to looking over at the point where the products enter the kiln for biscuit firing.

In the earthenware dipping house a Hopol dryer is used. The casting plant has been modernised, and the dust-removal equipment, also by Biddulph, has been described as the best of its kind in the district.

Modernised Firing Equipment

Modernising the firing equipment following the last war involved demolishing a Dressler oven installed in 1919, and, for a time, biscuit earthenware was fired with the tile biscuit in the Marlow. In 1946, an electrically-heated Birlec 18-in. moving belt oven was purchased to fire glost earthenware. However, continued expansion of business resulted in an electrically-heated Moore tunnel kiln being erected to do this work—the Birlec furnace being then switched over to enamel firing.

Nineteen-fifty saw a Gibbons-Got-

An operator charging the Birlec multi-passage furnace. Biscuit is shown on the two top rows of passages and glost in the lower

tignies multi-passage oven installed to deal with tea ware biscuit. This oven has twenty-four passages so arranged as to allow of twelve of these to be loaded from each end of the oven. Working a full 24-hour day, it is stated to be capable of firing 12,000 dozen of tea ware biscuit per week. A standard set of Bullers rings for this furnace is:

30	28	30	26
32	30	30	28
30	32	28	29
32	29	30	28
28	33	30	32
31	30	32	30

More recently, and with the original intention of glost firing the output of the Gibbons oven, a Birlec-Heurtey multi-passage furnace of similar construction has been installed. Since this was put into service, however, it has been used to fire both biscuit and glost at the same time.

The oven has sixteen passages arranged in banks of four—the top two banks handling biscuit, while the bottom two are used for glost. As in the case of the Gibbons, loading is carried out at both ends, an arrangement which makes for economy in operation in that it enables work which has passed through the heating chamber to pre-heat, in passing, the unfired ware which is moving into the furnace passages.

The over-all length of the furnace is 48 ft., and the ware is loaded on batts which slide on specially made basal refractories extending through each passage. Research, carried out under the direction of Mr. A. R. Harley-Jones, has established the most suitable batt design and body composition, so that batts are now cast, fired and machined on the works with excellent results as regards wear, length of life and slidability.

Hydraulic pusher gear, at both ends of the oven, push the loaded batts in procession through the passages at predetermined intervals. The former cycle of twenty-four pushes per day has now been stepped up to thirty-one, and it is now proposed further to increase this to forty pushes daily.

Power consumption during "running-in" is stated to have been 62 kWh., and labour required is two men per shift, one at each end of the oven to load and unload as required. Output, at thirty-one pushes per day, is reported to be 4,500 dozen biscuit and 4,500 dozen glost ware per week. On a temperature range of up to 1,200° C. a typical standard set of Bullers rings for the sixteen passages is as given below:

27	30	30	29
27	27	28	27
16	18	17	18
9	9	10	9

Designed to operate from 450-V. 3-phase, 50-cycle supply, power is fed to spiral-wound elements contained in the floor of the passages. Elements are replaceable without stopping the work.

Thermal Exchange

Mention has been made of the thermal exchange between preheating and cooling charges contained in adjacent passages. This, it should be said, is assisted by the use of open-work construction in the vertical walls separating the passages in the recuperative sections. As already stated, movement of the batts through the passages is by sliding, and the direction of movement of batts is always opposite to those in adjoining passages, either vertically or horizontally.

Volatile matter from the products in individual passages is exhausted via vertical flues under natural draught conditions. While in order to prevent ware spoilage, dust from abrasion between batts and passage floors is collected by suitable means. The firing section is arranged in four zones, each being controlled by automatic temperature regulation. A four-point recorder is also installed, and this is provided with additional contacts set a few degrees above the control temperature setting, so arranged as to switch off the oven in the event of the temperature exceeding a safe value.

Conclusion

All equipment at "Biltons" is installed in well laid out sections where operatives work under pleasant healthy conditions. The progressive methods first instituted by Mr. J. Tellwright when the business was founded, are continued by his co-directors A. R. Harley-Jones, F. Boulton and P. T. Tellwright, and are reflected in the consistently high standard of the ware passing from the factory.

The Broseley Clay Pipe Industry

A Craft that Dates Back to the First Elizabethan Era

by H. CLAYTON JONES

IT must surely be a unique experience to meet a man who keeps an excellent inn but very rarely takes a drink, and who has made tens of thousands of clay pipes yet is a non-smoker. This however, was my novel experience when I first met jovial Harry Southorn, the landlord of a popular hostelry at Broseley in Shropshire, and the proprietor of the pipe works there. For over three centuries this little Severnside town has been the cradle of the pipe making craft, for this modest branch of the ceramic art has been carried on there since medicinal herbs were smoked for pulmonary complaints, and tobacco had only just reached our shores.

The original pipe maker at Broseley no doubt was Richard Legg, for specimens of his work dated 1575 have been discovered. From Legg's day this humble country craft gradually developed into a thriving industry whose product found its way all over the world. At first pipe making was

Mr. Southorn, proprietor of the pipe works at Broseley, surveys his work

Fashioning dummies

strictly a domestic craft, the pipe shops being attached to the houses each of which had its own small kiln for burning or firing the pipes. Broseley was ideally situated for the work, having native clay at hand, coal for firing the kilns, and the river as a means of cheap if leisurely transport. Today, the clay for pipe making is imported from Newton Abbot in Devonshire because this West Country clay bakes out with a greater degree of whiteness.

One could name a score of famous Broseley pipe makers, specimens of whose work is eagerly sought after by collectors who can distinguish their different wares by the names, initials, or devices imprinted upon them. One early maker named Gauntlett had a gauntlet upon his pipes as a trade device.

When improved methods of pipe making were introduced at the end of the eighteenth century and the begining of the nineteenth the industry passed from a modest domestic craft to one of the factory. It was then that Noah Roden, a celebrated pipe maker, greatly improved the quality and design of pipes. Roden first supplied the then fashionable churchwardens to the London clubs and coffee houses, when the dilettantes, dandies, and indeed the intellectuals flourished the smooth clay pipe as a rival to the ornate snuff box. This was the London of the great Doctor Johnson, and it is noteworthy that Mr. Harry Southorn still supplies the 16-in. Broseley "straws" to the Johnson Society for their annual celebration at Lichfield, the great doctor's birthplace.

In 1823 Roden's business passed into the hands of William Southorn who brought the churchwardens and other clay pipes up to a very high degree of perfection. At the great exhibition in 1851 these pipes won distinction, while twenty years later, at the International Exhibition they were awarded a certificate of merit. William Southorn's father had been a pipe maker, and his brother, Edwin, also carried on a similar business at Benthall. In 1902 the Benthall works was incorporated in that of Broseley, and the firm as

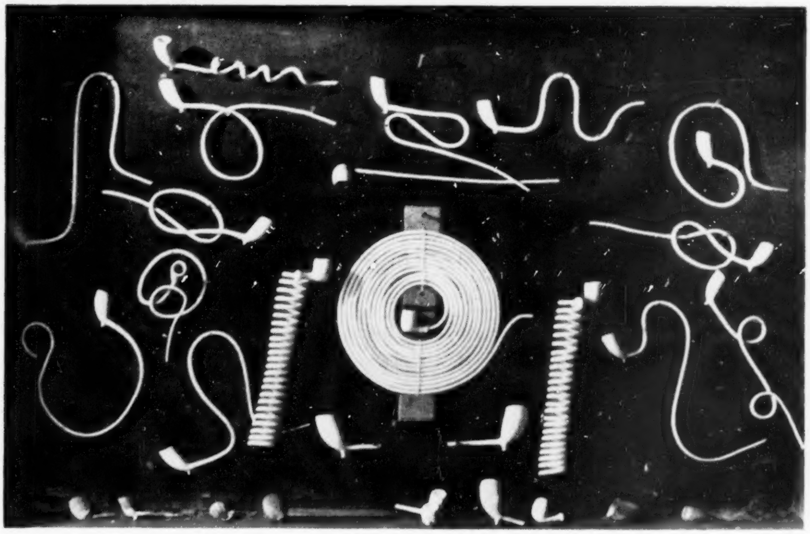
founded by William Southorn is today the only one surviving and represents one of Shropshire's most romantic and historic industries. From 1823 down to the present day the business has been conducted by successive members of the Southorn family and is still capably run by Mr. Harry Southorn.

There is a fascinating Dickensian atmosphere about Mr. Southorn's workshops, ornamented as they are with sporting prints and an assortment of clocks of as many varieties as the pipes that are fashioned there. It was in the moulding shop that Mr. Southorn told me how he and his son, together with a few young girls, and one old lady, who is between sixty and seventy years of age, turn out twenty gross of pipes a week. This old lady, by the way, has been making churchwardens for well over forty years, surely a unique record.

As in other branches of the ceramic art, the clay for pipe making is thoroughly dried, and afterwards, having been soaked to an even plastic form, passed several times through a pug mill. It is then rolled by hand into "dummies" of the length of the pipes to be made. A steel wire is then threaded through each dummy to form the vent after which it is pressed in a mould to give it the desired shape. The bowl is formed by the insertion of an iron stopper after which the pipes are left to partly dry. When rough edges have been removed by "finning," trade stamps impressed on to the pipes, and in the case of churchwardens the twist at the point of balance put in, the pipes are ready for firing.

Cutty pipes, and other short varieties, are thoroughly dried before being placed into round saggars or earthenware firing pots, but the longer pipes are sprayed with water until quite moist. The pipes are then placed in china clay dust, the curve of the long ones being produced by having a curved bottom to the saggar. The saggars are then built up in the kiln which is bricked up ready for burning. This process must be carried out very slowly at first, the heat afterwards being increased. The firing of a kiln needs 2 tons of coal and the operation takes about 16 hours. When the pipes are drawn from the kiln the mouthpieces are tipped with spirit varnish to prevent them sticking to the lips after which they are ready for use.

In spite of the popularity of other forms of smoking, the clay pipe is still in demand, chiefly in mining and agricultural districts. There is no lack of



Some novel pipes

variety in the design of Broseley pipes for, apart from the more orthodox shapes, Mr. Southorn showed the writer some very novel pipes, among them one shaped like a Catherine Wheel, and having a stem no less than 18 ft. long—certainly a cool smoke. The eagle, claw, grape, fish, and footballer designs are also still made.

Through the centuries Broseley pipes have maintained a reputation as a product of what is as much a noteworthy art as a noteworthy craft, and it may well be that the poet had a Broseley clay in mind when he wrote:

"The pipe with interposing puff
Makes half a sentence at a time enough."

Better Health in the Ceramic and Glass Industries

Survey of Recent Observations

by

DR. W. SCHWEISHEIMER
(New York, U.S.A.)

FOR several years a number of ceramic plants have been operated under contract to the Atomic Energy Commission to supply beryllium materials for Commission projetcs. As A. J. Breslin in a recent study has stated, no cases of beryllium poisoning have occurred at the plants which have been operated in compliance with Commission recommendations. The essential elements of an adequate health programme in such parts of the ceramic industry are (1) carefully planned operations with a minimum of manual handling, (2) sound local exhaust ventilation, (3) dust monitoring, (4) rigorous housekeeping, and (5) enforced personal hygiene.

Dust Control in Ceramic Industry

As W. C. L. Hemeon in a study on dust control in the ceramic industry points out, the adding of a small amount of water to flint dust is recommended for box car shipments, and for weighing and charging, as being better than exhaust ventilation, shipping in bags or other methods that have been advocated. The dust may present a silicosis hazard or it may be a nuisance. The former must be eliminated with the least delay, more time can be taken to eliminate nuisance dust. Measuring the silicotic hazards includes counting of dust particles, determination of the free silica and roentgenologic examination of the employees. Toxicity is being estimated by multiplication with the dustiness in the glass, silica brick and pottery industries.

Special Health Regulations for Potteries

In England special regulations for health and welfare of people working in potteries were issued a few years ago. Here are some of the more important regulations. Washing facilities with hot and cold water are required, and towels, soap and nail brushes must be provided. For workers in specified occupations mess rooms must be provided. No person working on a scheduled process may take food, drink or tobacco without first washing his hands.

In each workroom, ventilation must be so arranged as to prevent direct draughts from air inlets on to workers. Generally the drying of ware by means of heat shall be done in special stoves. The temperature in any workroom may not exceed 75° F. unless the external temperature is over 65° F., and then the shop temperature must not be more than 10° F. above the shade temperature in the open air. In certain shops 55° F. is to be the minimum temperature after the first hour of work.

Efficient exhaust draught is required for a variety of processes, and these must be carried on wherever possible under a suitable hood. Screens, sieves and other appliances for handling dry materials must be enclosed and have exhaust draught. Dust removed by exhaust plants must not be allowed to escape into any workroom. Air discharged from such plants must be discharged into the open air.

There are provisions as to the construction, maintenance and cleaning of floors

and work benches, the preparation and storage of clay dust, the control and spacing of tile presses, the use of raw lead compounds, glazing, colour blowing, hydrofluoric acid, lithographic transfer making, and separation of processes.

The cleaning of potters' shops shall be done by adult males and with vacuum cleaning apparatus. Respirators are to be provided for use where specified.

No young person may be employed as a wheel turner at a tile press, or at a number of scheduled processes, such as making of frits or glazes containing lead or colours, the blowing, dusting or grinding of colour, or any other process in which any material other than glaze which contains more than 5 per cent. of its weight of solid lead compound (as lead monoxide) is used other than in oil or similar medium.

Glazes Containing Lead

The use of glazes containing lead, and the use of ground or powdered flint or quartz, in the manufacture or decoration of pottery are liable to cause risk of bodily injury to workers. Official Regulations in Great Britain apply to all factories where in the manufacture or decoration of pottery glaze other than salt glaze is used, or ground or powdered material is used for specified purposes, or where flint or quartz is mixed with clay to form the body of the ware.

The use of certain glazes is prohibited, only leadless glazes for low-solubility glazes may be used in the manufacture of pottery. According to the Regulations, ground or powdered flint or quartz may not be used for (a) the placing of ware for the biscuit fire; (b) the polishing of ware; (c) as an ingredient in a wash for articles used in support of ware during firing; or (d) dusting or supporting in potters' shops.

Effect of Calcined Alumina on Pottery Workers

The power of powdered pure aluminium metal and certain forms of alumina to diminish the solubility of quartz in vitro and in living tissues has been demonstrated, but whether inhalation of these substances is safe and of value in the prevention and treatment of silicosis in man is not yet established. A. Meiklejohn and W. W. Jones published the results of a field study in a group of pottery workers in North Staffordshire on the effect of the use of calcined alumina in china biscuit placing on the health of the workmen. Here are some of their results.

Until 1929 finely powdered calcined flint was the medium used in placing of china tableware for biscuit firing. The china biscuit placers suffered excessively

from silicosis. Calcined alumina was found to be a satisfactory substitute for the flint and a medical inquiry had indicated that this alumina did not damage the health of the workmen. Thus assured china manufacturers commenced to adopt alumina as the bedding medium. The particular variety of alumina used is Corundum. By a follow-up of the workmen examined in the original alumina inquiry it was confirmed that this form of alumina has no adverse effect on the health of workmen.

Silicosis in Potteries

The pottery industry is one of the few occupations in which women are exposed to concentrations of silicon dioxide sufficient to produce silicosis. A high percentage of the workers in this industry are women, and among the skilled tasks which they perform is "finishing," a process which creates a fine dust containing a large amount of silicon dioxide. Dr. Joseph T. Noe recently found the incidence of silicosis among those women employed as finishers about 11 per cent. Most women silicotics have changed to dust-free work on medical advice. Those who continue to work as finishers are usually women who have been working at that specific job for many years and,

although aware of their condition, seldom file claims for compensation.

Etching of Glass and Injury

A German physician, Dr. E. Beck, presented the case of a woman who had used hydrofluoric acid in the etching of glass. Absorbed in her work, she had not noticed that the (undiluted) acid had run along the wooden handle holding a saturated cotton plug and had reached her fingers. An ointment bandage was applied, but unbearable pains developed. The injuries took a serious turn, the two involved fingers, after seven weeks, had to undergo an operation. Healing finally took place after that.

Dr. Beck says that although such lesion may at first appear to be harmless, injection of calcium gluconate (10 per cent. solution) around the lesion should be made at once in order to prevent further spreading. Magnesium sulphate (20 per cent. solution) is less effective.

Nose and Glass Workers

The Italian physician, Dr. L. Bernabei, recently reported ten cases of perforation of the nasal septum (formation of a hole) in glass workers. The glass workers involved in the mishap were in charge of preparing the mixtures used in the production of glass. These mixtures contained 59 per cent. silica and 40 per cent. anhydrous sodium carbonate. As the department where the perforations occurred had thirteen workers in all, the incidence was about 77 per cent., a very high percentage. All the patients had a certain kind of lung trouble (micronodular pneumoconiosis). Dr. Bernabei points out the need of technical improvements in glass factories. The preventive measures he suggests include the obligatory use of masks and periodical medical examination.

Glass Industry in Argentina

Dr. E. P. Navarini reported that in the glass industry in Argentina a six-hour working day has been established. Of the various health measures he discusses, he stresses the importance of an adequate supply of water, of a sufficient number of baths or showers, of clean clothing, of an adequate diet and of suitable recreation. He emphasises the fact that the modern glass industry is highly mechanised, and physical strength is of less importance for most of the workers than is intelligence and dexterity.

Methods of Test for Chemical Stoneware

FIFTEEN years after the first publication of B.S. 784 "Testing of Chemical Stoneware," a revision (B.S. 784:1953) has been published by the British Standards Institution. During that period certain of the tests specified have been found to be of academic interest only and others have been superseded by newer tests.

The new document gives the following test methods with full details of apparatus, test piece and procedure:

1. *Determination of resistance to compression.* The size of test piece has been closely defined because results seem to vary with differing sizes and shapes.

2. *Determination of transverse strength.* This test is basically the same as the method for determination of resistance to cross bending. It is felt, however, that it does not give a true modulus of rupture for stoneware, and although a reliable comparison of stoneware can be obtained with it, the results should not be used for design calculations on stoneware apparatus without considerable factors of safety.

3. *Determination of resistance to abrasion.* A more accurate method has been adopted.

4. *Determination of true specific gravity.* Only minor changes have been made, but specific gravity has been substituted for density.

5. *Determination of apparent specific gravity, apparent porosity and water absorption.* The use of paraffin for this test has been replaced by water. Instead of necessitating a separate test, the water absorption is calculated from the result.

6. *Determination of thermal expansion.* Owing to errors caused by the casual heating of the dial gauge and support on on the older vertical apparatus, this test has been superseded by one using a horizontal test piece.

7. *Determination of resistance to thermal disruption.* This is a new test based on the lowering of the transverse strength of stoneware after subjecting it to specified degrees of thermal shock.

8. *Determination of acid soluble iron.* A more accurate method has been adopted.

9. *Determination of resistance to acid.*

The resistance of stoneware to acid attack is extremely high. It is, therefore, only possible to obtain a result by breaking down the sample to get an extremely large surface area and by using concentrated acid. This test must not be confused with "acid solubility" as given in some other British Standards obtained by using a single piece immersed in weak acid.

Copies of this standard may be obtained from the British Standards Institution, Sales Branch, British Standards House, 2 Park Street, London, W.1. Price 3s.

AN AUTOMATIC STOKER FOR COKE

The Mirrlees Watson Coke Stokers are the result of practical experience combined with much recent development work.

The stoker makes special provision for withstanding the abrasion of coke. Feedworm trough and hopper base are protected by hard, replaceable, earthenware tiles, and the feedworm is of very heavy section chrome cast-iron, assembled in replaceable sections. In addition, the feedworm trough is of large cross section, and is only partially filled with coke—an important feature in avoiding packing and crushing. Also the feedworm is tapered or metered at the hopper end, with the same object.

The retort is of unusually heavy section and is provided with cooling ribs, and the construction generally is very massive. It is placed inside the boiler where the maximum use is made of the radiant heat from the firebed. No form of precombustion chamber is required.

A large grate area is provided to avoid a high-burning rate and provide easier temperature conditions within the firebed. The hopper is totally enclosed and sealed. It is also under slight air pressure to prevent smoking back from the retort. This range of stokers is made in eight sizes, ranging from a capacity of 35 lb. of coke per hour to 600 lb. per hour.

The stokers are of particular value in "smokeless zones." Automatically-controlled, they maintain the required heat output or steam pressure. The Mirrlees Coke Stoker burns the smaller grades of gas coke or furnace coke, and is also suitable for burning the normal bituminous coals suitable for underfed stokers.

Safety and Relief Valves.—From the Crosby Valve and Engineering Co. Ltd., Crosby Works, Ealing Road, Wembley, Middlesex, we have received a new catalogue (P1500) dealing with the company's range of safety and relief valves. This is well illustrated with line drawings showing the working of these valves, and contains numerous tables of useful information. Copies are available from the technical sales manager at the above address.

NEW CENTRIFUGAL PUMP

THIS new motor-driven pump has been designed to meet the demand for a high performance pump at a price within the range of all. The pump is direct-coupled to an entirely new J.A.P. model 80 two-stroke engine, and the performance figures are as follows:

Maximum total head ...	110 ft.
Maximum output ...	4,000 g.p.h.
Guaranteed suction lift ...	25 ft.

The total weight of the complete unit is only 40 lb., enabling it to be easily carried by one person by the handle provided. The mounting is an alloy base-plate fitted with rubbers to absorb shock and to prevent "creeping."

The J.A.P. model 80 engine is fitted with a hand throttle control operated from the carrying handle. Thus, a range of outputs from a mere dribble to the maximum 4,000 g.p.h. can be obtained, thus really economical fuel consumption is achieved under all pumping conditions.

An exclusive self-priming device is incorporated ensuring rapid automatic repriming up to a guaranteed suction lift of 25 ft. without the use of a foot valve on the suction hose. The unit will satisfactorily handle liquids containing up to 25 per cent. solids, liquid mud, paint, sewage sludge, slurry, oil and petrol, chemicals, etc. It is suitable for spraying, water supply, fuel supply, washing down, emergency fire fighting and innumerable other uses.

The new pump has been produced primarily to meet competition in overseas markets, and production is commencing immediately. Supplies are expected to be available for the home market in about four weeks.

Further details can be obtained from the manufacturers: Goodenough Contractors' Machinery Ltd., of Twickenham and Weybridge.

Smoke Abatement Exhibition.—Because of the interest created by their exhibition at Charing Cross Underground Station last year, the Solid Smokeless Fuels Federation, of 74 Grosvenor Street, London, W.1, by kind permission of the London Transport Executive, is holding another and more comprehensive exhibition, again at Charing Cross, from 15th February to 9th March, 1954.

Northern Consultative Council.—The Minister of Fuel and Power has appointed Mr. D. Nicholson Carr, of Carlisle, to be a member of the Northern Gas Consultative Council.

ADVERTISERS' INDEX

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